

SINGLE CHIP LCD TIME/SECONDS/DATE WATCH CIRCUIT

- On Chip Voltage Multiplier
Provides 4.5V For Driving 3½
Digit Field Effect Display
- Only Two Switches Required
For Complete Operation Of The
Watch
- Operates With 32.768 kHz
Quartz Crystal
- Anti-Bounce Protection On
Switch Inputs
- AM/PM Indication When Setting
Time

The 5810A is a low power timekeeping circuit intended for use with 7 segment, 3-1/2 digit field effect liquid crystal displays. All of the circuitry required in a Time/Seconds/Date watch is contained on this single chip.

An on-chip voltage multiplier is incorporated on the 5810A. The multiplier derives a 4 to 4.8 volt display drive supply from the 1.5 volt battery. This multiplier requires only three external capacitors.

The 5810A, in conjunction with an external quartz crystal and trimmer capacitor, oscillates at 32.768 kHz, divides down and decodes Seconds, Minutes, Hours, and Date of Month.

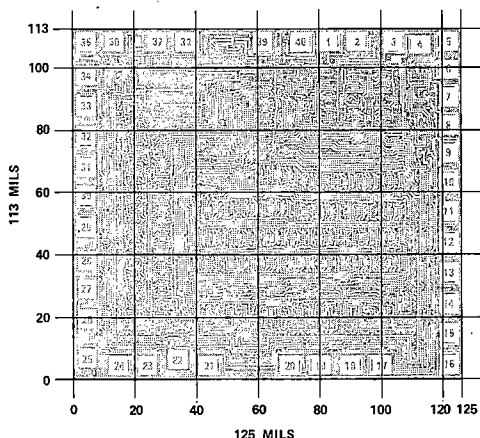
The 5810A will normally display Hours and Minutes. Closure of the D/C command switch will cause Seconds to be displayed in the Minutes position and the Hours will be blanked. A second closure of the D/C command switch will cause the Date to be displayed in the Minutes position and Hours to be blanked. A third closure of the D/C command switch will cause a return to the normal mode displaying Hours and Minutes. Switch S is used in conjunction with switch D/C for timesetting operations (see page 11-4 for description of operation). Thus only two switches are required for complete operation of the watch.

The colon is flashed at a 1Hz rate in all three display modes.

To facilitate testing and calibration a fast test input, reset and oscillator calibrate output are provided. These functions are described on page 11-4.

The 5810A is manufactured with complementary silicon gate MOS. This extremely low power technology is ideally suited for the manufacture of devices designed to operate on small batteries for long periods of time.

CHIP TOPOGRAPHY



PAD ASSIGNMENT

- | | |
|-------------|----------------------|
| 1. D/C | 21. B3 |
| 2. S | 22. Fast Test |
| 3. VDD | 23. C3 |
| 4. GND | 24. D3 |
| 5. Cap 1 | 25. E3 |
| 6. Cap 1 | 26. C2 |
| 7. Cap 2 | 27. A2 + D2 |
| 8. Cap 2 | 28. E2 |
| 9. VTT | 29. L |
| 10. G1 | 30. C1 |
| 11. F1 | 31. D1 |
| 12. A1 | 32. E1 |
| 13. B1 | 33. K |
| 14. G2 | 34. Common |
| 15. F2 | 35. Calibrate Out |
| 16. A2 + D2 | 36. Oscillator Cap 1 |
| 17. B2 | 37. Oscillator Cap 2 |
| 18. G3 | 38. Oscillator Out |
| 19. F3 | 39. Oscillator In |
| 20. A3 | 40. Reset |

Absolute Maximum Ratings*

Temperature Under Bias	.....	-20°C to +70°C
Storage Temperature	.....	-40°C to +125°C
Supply Voltage V_{DD} with respect to GND	.....	-8.0V to +0.3V
Voltage on all Inputs or Outputs with respect to GND	.....	V_{DD} -0.3V to +0.3V
Power Dissipation	.....	100mW

*COMMENT:

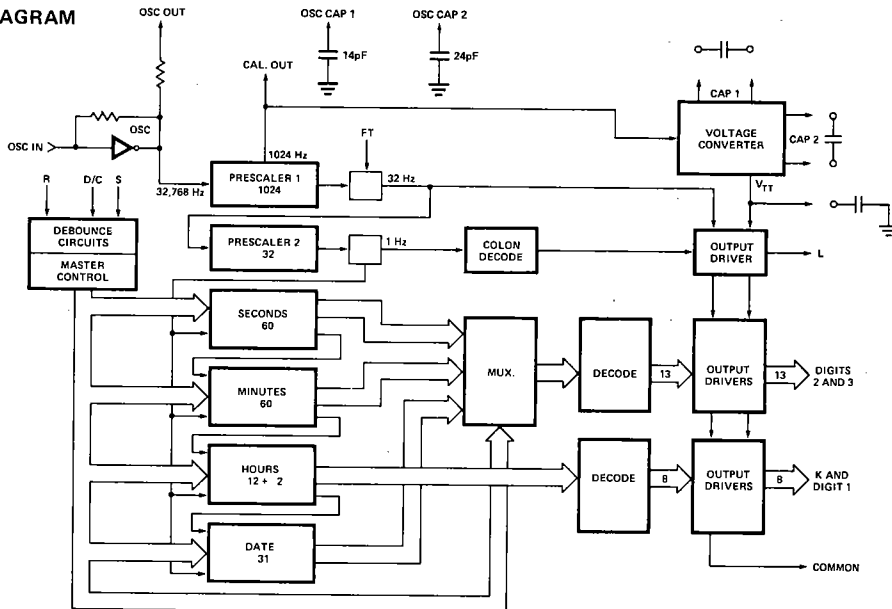
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

D.C. and Operating Characteristics

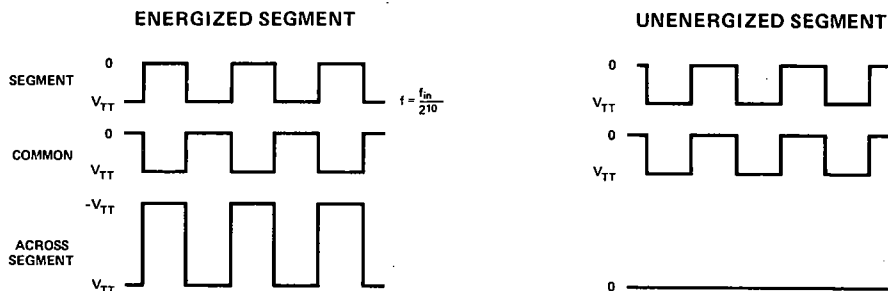
$T_A = 25^\circ\text{C}$; $V_{DD} = -1.6\text{V}$; $f_{OSC} = 32.768\text{ kHz}$, Unless Otherwise Specified.

Symbol	Parameter	Min.	Max.	Unit	Test Condition
I_{DD}	Total Average Internal Current		5	μA	No Output Load
			10	μA	1 μA Output Load
V_{TT}	Multiplier Output Voltage		-4.8	V	$I_{OUT} = 0.0\mu\text{A}$
		-4.0		V	$V_{DD} = 1.5\text{V}$, $I_{OUT} = 1.0\mu\text{A}$
I_{IHS}	Switch Input High Current (D/C, S)		4	μA	$V_{IN} = 0\text{V}$
V_{IL}	Input Low Voltage	$V_{DD} - 0.3$	$V_{DD} + 0.4$	V	
V_{IH}	Input High Voltage	-0.3	0.3	V	
$V_{DD\text{ START}}$	Minimum Oscillator Start Voltage	-1.4		V	
$V_{DD\text{ SUST}}$	Minimum Oscillator Sustaining Voltage	-1.3		V	
V_{OLC}	Output Low Voltage Common		$V_{TT} + 0.1$	V	$V_{TT} = -4.0\text{V}$; $I_{OLC} = 1.0\mu\text{A}$
V_{OHC}	Output High Voltage Common	-0.1V		V	$V_{TT} = -4.0\text{V}$; $I_{OHC} = -1.0\mu\text{A}$
V_{OLS}	Output Low Voltage Segment		$V_{TT} + 0.1$	V	$V_{TT} = -4.0\text{V}$; $I_{OLS} = 50\text{nA}$
V_{OHS}	Output High Voltage Segment	-0.1V		V	$V_{TT} = -4.0\text{V}$; $I_{OHS} = -50\text{nA}$

BLOCK DIAGRAM

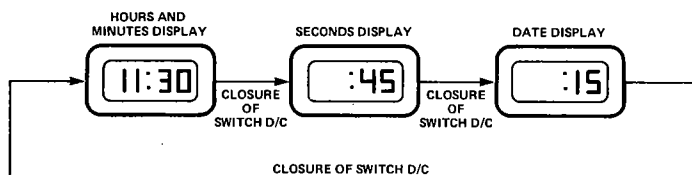


Output Waveforms



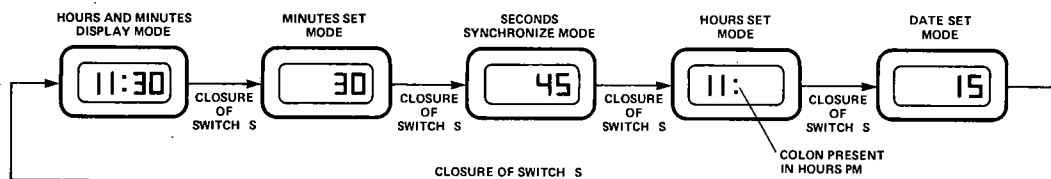
Time Display

Switch input D/C controls the time display modes. Each closure of switch D/C (D/C input = high) causes a change in the display mode in the sequence Hours and Minutes → Seconds → Date → Hours and Minutes. The following diagram illustrates this:



Time Setting

Switch input S controls the time setting modes. This switch input is active only when the circuit is in the Hours and Minutes display mode. Each closure of switch S (S input = high) causes a change in the time set modes in the sequence Hours and Minutes → Minutes → Seconds → Hours → Date → Hours and Minutes. Closure of switch D/C when in the Minutes, Hours, or Date time set modes will cause that mode to be advanced at a 1 Hz rate. Closure of switch D/C in the Seconds synchronize mode will cause the Minutes to be advanced by one and the Seconds to be reset to zero and held until the D/C input is returned high. The colon is displayed only in the Hours PM state in the time set mode. The following diagram illustrates this:



Reset

The reset input may be used to initialize all time counters to the zero state. All time counters are automatically reset to zero when voltage is initially applied to the circuit. The zero state is 12:00 AM, 00 Seconds, 0 Date.

Fast Test

This input by-passes the oscillator stage and prescaler 1, allowing cycling of the counters at rates faster than real time.

Calibration Output

This output brings out the oscillator frequency divided by 32 and may be used for calibration of the oscillator.

DIGITS D1, D2 AND D3 TRUTH TABLE

